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Identifying the effective concentration for spatial repellency of the dengue vector *Aedes aegypti*

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Abstract

Background: Current efforts are underway to quantify the chemical concentration in a treated air space that elicits a spatial repellent (deterrent) response in a vector population. Such information will facilitate identifying the optimum active ingredient (AI) dosage and intervention coverage important for the development of spatial repellent tools – one of several novel strategies being evaluated for vector-borne disease control. This study reports initial findings from air sampling experiments conducted under field conditions to describe the relationship between air concentrations of repellent AIs and deterrent behavior in the dengue vector, *Aedes aegypti*.

Methods: Air samples were taken inside and outdoors of experimental huts located in Pu Tuey Village, Kanchanaburi Province, Thailand in conjunction with mosquito behavioral evaluations. A mark-release-recapture study design using interception traps was used to measure deterrency of *Ae. aegypti* against 0.00625% metofluthrin coils and DDT-treated fabric (2g/m^2) within separate experimental trials. Sentinel mosquito cohorts were positioned adjacent to air sampling locations to monitor knock down responses to AI within the treated air space. Air samples were analyzed using two techniques: the U.S. Environmental Protection Agency (USEPA) Compendium Method TO-10A and thermal desorption (TD).

Results: Both the USEPA TO-10A and TD air sampling methods were able to detect and quantify volatized AIs under field conditions. Air samples indicated concentrations of both repellent chemicals below thresholds required for toxic responses (mortality) in mosquitoes. These concentrations elicited up to a 58% and 70% reduction in *Ae. aegypti* entry (i.e., deterrency) into treated experimental huts using metofluthrin coils and DDT-treated fabric, respectively. Minimal knock down was observed in sentinel mosquito cohorts positioned adjacent to air sampling locations during both chemical evaluations.

Conclusions: This study is the first to describe two air sampling methodologies that are appropriate for detecting and quantifying repellent chemicals within a treated air space during mosquito behavior evaluations. Results demonstrate that the quantity of AI detected by the mosquito vector, *Ae. aegypti*, that elicits repellency is far lower than that needed for toxicity. These findings have important implications for evaluation and optimization of new vector control tools that function through mosquito behavior modification as opposed to mortality.

Keywords: Spatial repellency, Air sampling, *Aedes aegypti*, Mosquito behavior, Experimental hut, Chemical concentration, DDT, Metofluthrin

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